Safe maize for Africa:

Capacity and Action for Aflatoxin Reduction in Eastern Africa (CAAREA)

BecA-CSIRO Partnership Flagship Project

A shared mycotoxin and nutritional analysis research and capacity building platform has been established at the BecA-ILRI Hub in Kenya, with funding from the Australian Government and scientific involvement of researchers from Kenya, Tanzania, Australia, USA and South Africa. The multinational, multidisciplinary BecA-CSIRO aflatoxin project team is conducing research that has provided key insights and tools for reducing aflatoxins in the region, and will be piloting integrated sets of interventions with smallholder farmers, and actors along the formal maize value chain as part of its upcoming second phase. Since it was established in 2010, the platform has hosted almost 50 researchers, including NARS scientists from seven countries, researchers from Australia and the USA, and a number of international research centers. The Australian Government Department of Foreign Affairs and Trade is continuing funding for this project through 2018.

Phase I (2011-) Project: Capacity and Action for Aflatoxin Reduction in Eastern Africa (CAAREA)

1. Establish a shared **mycotoxin/nutritional analysis research platform** at the BecA-ILRI Hub, including gold standard and novel aflatoxin diagnostics: BSL2 mycology lab, milling room, cold rooms; LCMS/UPLC, VICAM, ELISA, GCMS, AAS, UVVIS, NIR. Used by almost 50 researchers since 2011, multiple hosted projects, open for NARS researchers and their partners.

2. **Characterize maize fungi** from around Kenya and Tanzania: information, biobank and inoculum (see 3). Hosted NARS projects also characterized fungi from Burundi, Cameroon, Ethiopia, Kenya, Tanzania, and others, using same analyses – comparable for regional comparison.

3. **Identify maize germplasm resistant to aflatoxin accumulation** (G x E x M) through first inoculated field trials in the region (led by: Kenya – KARI; Tanzania – ARI-Uyole/Open University of Tanzania): a total of 14 field trials conducted (at 7 locations over 3 years, not every trial at every site each year).

4. Test **modelling** as a potential predictive tool and to contextualize findings regionally (risk maps, process models): APSIM model to predict maize aflatoxin risk, on farm survey to characterize maize cropping systems (management practices – planting to consumption, maize genotype mapping – GBS, multiple mycotoxin analysis by LCMS at BecA and QAAFI).

Project Team and Partners

Project team, 2013 Annual Project Workshop

Phase I and *new to Phase II*

Funding:
Australian Government, Department of Foreign Affairs and Trade (DFAT) – formerly Australian Agency for International Development (AusAID).
Tesfaye Legesse, Paul Greener and others: various project input

Project Leader: Jagger Harvey, Senior Scientist, BecA-ILRI Hub, j.harvey@cgiar.org

BecA-ILRI Hub:
Jagger Harvey (Project Leader, geneticist); Robert Ngeno (lab manager, analytical chemist); James Wainaina, Immaculate Wanjuki, Fredrick Nganga, Sundy Akello, Eric Magembe and others (research assistants); Benoit Gnonlonfin (postdoc, mycologist); Samuel Mutiga (Cornell PhD student); Warwick Turner (analytical chemist, also QDAFF); Boniface Muganda (database systems); Ethel Makila (communications); Jacquiline Mayira, Rachael Mwangi, Berine Ada, Rachel Njunge, Valerian Aloo, Josephine Birungi, Timothy Kingori, Agnes Mburu and many others (administrative and logistical support); Appolinaire Djikeng (BecA Director, BecA-CSIRO Partnership Leader, strategic project input).

Kenya
Kenya Agricultural and Livestock Research Organization (KALRO; formerly KARI): James Karanja (national maize breeder), Charles Kariuki (entomologist), James Gethi, KARI Katumani; Anne Gichangi (agricultural economist) KARI Njoro; Festus Murithi (socioeconomist), and teams.

Tanzania
Agricultural Research Institute - Uyole: Arnold Mushongi (national maize breeder) and team
Ministry of Agriculture and Food Security: Deogratias Lwezaura (agricultural economist) and team
Open University of Tanzania: Said Massomo (plant pathologist), Fabian Manoza (MSc student), and others.
Nelson Mandela African Institute of Science and Technology (NMAIST): *Martin Kimanya*

Australia
CSIRO: Ross Darnell (biometrician, Australia project coordinator); Nai Tran-Dinh (mycologist); Stephen Trowell and Amalia Berna (biosensor technology); Larelle Macmillan (communications); Peter Carberry and Bruce Pengelly (BecA-CSIRO Partnership Leader, strategic project input including modelling); *Andrew Hall (innovation systems); Mario Herrero (household modelling)*
CSIRO/HarvestChoice: Darren Kriticos (ecological modeller)
University of Queensland/Queensland Alliance for Agriculture and Food Innovations (QAAFI): Mary Fletcher (natural product organic chemist); Glen Fox (NIR expert); Titilayo Falade and Ben Temba (PhD students).
Queensland Department of Agriculture, Forestry and Fisheries (QDAFF): Yash Chauhan (APSIM modelling); Warwick Turner (analytical chemist)
Diversity Arrays Technology Pty Ltd: Andrzej Kilian (genomics)

USA
Cornell University: Rebecca Nelson (molecular plant pathologist); Michael Milgroom (population biologist)
Helica Biosystems Inc: Wondu Wolde-Mariam – subsidized rates on kits, and technical advice.
HarvestChoice/University of Minnesota: Phil Pardey (agricultural economist), Jason Beddow (postdoc, applied economics), Noboru Ota (GIS input).

South Africa
University of Pretoria/HarvestChoice: Frikkie Liebenberg (survey coordination)

Development Partners:
Farm Input Promotions Africa (FIPS): David Priest and team
Kenya Cereal Millers Association (CMA): Paloma Fernandez and others; engaged in Phase I
Partnership for Aflatoxin Control in Africa (PACA): Amare Ayelew and team; engaged in Phase I.

Phase II (future proposed) Project: Aflatoxin Action Alliance

Purpose: Researchers, private and public sector actors, women and men farmers and civil society collaboratively develop and apply new knowledge and innovations that improve the accessa nd availability of aflatoxin-safe maize.

Outcomes:
1) Farmers, millers and others have improved access and availability of aflatoxin-safe maize.
2) Participating scientists and institutions incorporate adoption partners and pathways in bioscience design and implementation.

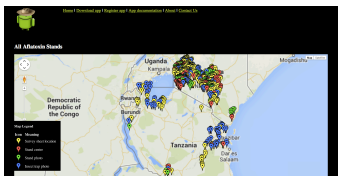
Project components:

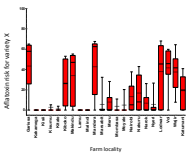
1. Continue development and improvement of aflatoxin tools and information for use in piloting aflatoxin reduction strategies along value chains: sampling and diagnostics, decontamination and sorting, modelling-based decision support tools (process APSIM, risk mapping, and hybrid statistical, and household models to identify risk factors, model their potential impact on aflatoxin reduction).

2. Engagement of key actors in small, focused innovation platforms (Aflatoxin Action Alliances) to consider and discuss information and new findings/tools and their use for reducing aflatoxin along value chains, forming new institutional and other collaborations to address key agenda issues.

3. Pilot deployment of integrated aflatoxin intervention strategies (information, practices and tools) with subsistence farmers. Includes matching varieties to environments in which they have lower risk of aflatoxin accumulation, appropriate pre-harvest management, drying and storage practices and tools, and on farm/commercial mill testing and decontamination. Objective: pilot interventions with at least 30,000 farmers in high risk areas in Kenya and Tanzania.

4. Pilot deployment of aflatoxin intervention strategies (information, testing) along small, pilot formal maize value chain. Includes characterizing reduction of aflatoxins in the food supply, and behavioral economics to assess affect of interventions with different actors along the chain to devise sustainable and effective approaches.





Engaging with the BecA aflatoxin platform

Capacity building: The BecA-ILRI Hub was established to build capacity and complement the strengths of African scientists working on key constraints to African agriculture. The aflatoxin team can provide advice, contacts, technical protocols, and other information.

Hosting research projects: The mycotoxin, nutritional analysis and broader BecA-ILRI Hub research platforms were established to host research projects focused on African agricultural improvement. A range of projects have already been hosted at the mycotoxin-nutritional analysis platform, including NARS projects from seven sub-Saharan African countries, Australia, USA, and a number of international research institutes.

Research tools and information: Research outputs from the Australia-funded aflatoxin project include information on sampling and testing procedures suited to different contexts, on farm and village level maize mycotoxin surveys, Agriculture Production Simulation (APSIM) models for predicting aflatoxin risk for different maize varieties, and others.

Funding opportunities: The BecA Africa Biosciences Challenge Fund (ABCF) is a competitive fund available to African researchers, to support a 4-9 month research placement in our laboratories. We receive a large number of applications focused on mycotoxin and nutritional analysis research; you are encouraged to apply, and to be as specific as possible in your objectives and experimental workplan.

Policy and other stakeholder information: The aflatoxin team has published a policy brief and will continue to provide distilled information of use to policymakers and other key stakeholders, upon whom we rely for transformative change to address the spectre of aflatoxins in the region.